

slowly southward along the eastern slope, followed by several days of severe cold weather for the season of the year. Cold wave warnings were issued for eastern Colorado on the morning of the 3d. The warnings were verified in the greater part of the area for which the warnings were issued. However, still lower temperatures occurred in eastern Colorado on the mornings of the 6th and 7th, several stations reporting the lowest temperatures of record for March.—*Frederick W. Brist.*

San Francisco Forecast District.—The pressure distribution over the Pacific Slope during March showed a marked change from that of the two preceding months. The hitherto prevalent high areas over the Rocky Mountain and Plateau regions gave way to frequent low areas moving in over British Columbia, and the Pacific HIGH moved southward and impinged on the southern Oregon and California coasts.

This pressure distribution was nearer the normal seasonal condition than had obtained heretofore this winter and precipitation occurred oftener and in greater amounts throughout this district. In eastern Oregon, western Idaho, northern Nevada, and California, except on the extreme north coast, the precipitation was above normal, the excess being greatest in the San Joaquin valley and southern California. In those sections where the precipitation was below the average, the amounts were greater than in either of the two preceding months. The snowfall on the ground in the mountain regions remains much below the average.

The temperature was generally slightly below normal in all sections, and there were no marked warm or cold spells.

On 11 days warnings were issued for light to heavy frosts in portions of California. The warnings were generally verified, but the frosts were not severe enough to cause serious damage.

Storm warnings were issued 15 times during the month and in most instances were verified.

On the 21st and 22d frequent reports were received by radio from the S. S. *Manoa*, at that time in a severe storm about 500 to 600 miles off the central California coast. The reports were of great assistance in determining the extent and probable duration of the storm at that time making its appearance on the coast.—*G. H. Willson.*

RIVERS AND FLOODS, MARCH, 1920.

By ALFRED J. HENRY, Meteorologist in Charge.

[Weather Bureau, River and Flood Division, Washington, Apr. 30, 1920.]

March is preeminently the month of maximum flood frequency east of the 100th meridian and the current month was no exception, although it may be said that there was no severe and widespread flood in any part of the country.¹

At the beginning of the month the snow cover in the Northern Middle Atlantic States and New England was of very considerable depth and by reason of the prevailing low temperature of the preceding months it was well packed and contained a large water content. The presence of this great snow blanket which ranged from 10 to 15 inches in depth over northern Pennsylvania and New

York increasing to between 2 and 3 feet over New England and the near approach of thawing weather was the cause of some alarm in many localities. As often happens in the case of well-packed snow, the flood menace is not great; in this case the flood waters from the melting snow and moderate rains passed down the streams generally without special incident.

There were rather frequent short periods of rain with temperatures above freezing in northern watersheds but at no single time did the elements combine to cause disastrous floods.

The rivers of eastern Pennsylvania reached flood stage on the 5th and 6th as the result of thawing weather and rain coupled with the breaking up of the ice. The mills of Manayunk, Philadelphia, were obliged to remove perishable goods from the first floor of their establishments and to suspend operations for two days on account of high water. About a week later a short spell of warm weather attended by rain started a general break up of the ice in the streams of eastern New York and eastern Pennsylvania. Many ice gorges were formed and there was more or less local flooding as a result. The Hudson at Albany and Troy passed above the flood stage on several occasions during the month and remained close to flood stage at the end of the month.

The ice broke up in the Connecticut on the closing days of the month, starting on White River on the 25th. There was more or less flooding of the lowlands and damage that could not be prevented. The Connecticut at Hartford remained in flood until April 9.

The Susquehanna of Pennsylvania and New York after an unusually long icebound period began to break up in the upper tributaries in Pennsylvania as early as the 6th and was clear of ice down to Harrisburg by the 13th. The principal flood occurred on the 13th and 14th.

Moderate rain floods occurred in the streams of the South Atlantic and East Gulf drainage, also on the upper Trinity of the West Gulf drainage.

In the Great Lakes drainage the majority of the streams in lower Michigan and northern Ohio and Indiana reached flood stages during the period 12th to 17th.

In the upper Mississippi drainage in Wisconsin and Minnesota the streams did not attain flood stages until near the end of the month. The heavy rain of the 25th and 26th, together with the runoff from melting snow, caused a sharp rise in the streams, which crested with slightly above flood stages on the closing days of the month. The crest of the flood in the upper Mississippi on the 31st was below Reeds, Minn.

The Mississippi proper.—As above indicated the spring rise had set in at the close of the month and there was also a moderate flood in the river below the mouth of the Missouri. The upper tributaries of the Ohio were in flood, some as early as the 6th and practically all of them again on the 13th. By the time flood waters of the last named had reached the lower reaches of the streams heavy rains over Kentucky and Tennessee caused floods in the rivers of those States which synchronizing with high water in the main river as well as in the Mississippi below St. Louis resulted in a stage of 51.4 feet on the Cairo gage on the 31st. On that date the Mississippi was in flood from below Reeds, Minn., to Arkansas City, Ark. The subsequent history of this Mississippi flood belongs to the record of April.

¹ For note on conditions in the West, see "The snowfall in the Western States, winter 1919-20, p. 156.

The usual details as to flood stages and the estimated money loss due to floods may be found in the tables below:

Estimates money loss due to floods.

River or district.	Tangible property, bridges, railroads, etc.	Crops prospective.	Live stock.	Suspension of business.	Value of warnings.
Connecticut.....	\$260,000		500	\$1,000	\$3,500
Hudson.....	3,000				
Susquehanna.....	100,000				
Grand (Michigan).....	1,250				
Saginaw.....	3,700			500	
Wisconsin.....	10,500			28,305	30,000
Ohio:					
Pittsburgh.....	25,000				
Louisville.....	10,000				
Wabash.....		4,000	2,000		250,000
Arkansas:					
Fort Smith.....	40,000	8,000			8,000
Trinity:					
Dallas.....	4,500	6,000			
Peedee:					
Charleston.....				2,000	5,000
Total.....	457,950	18,000	2,500	31,805	296,500

¹ Suspension of business and cleaning up.

TABLE I.—Flood stages March, 1920.

River and station.	Flood stage.	Above flood stages—dates.		Crest.	
		From—	To—	Stage.	Date.
ATLANTIC DRAINAGE.					
Connecticut:	Feet.			Feet.	
White River Junction, Vt.	13	25	(**)	17.6	26
Bellows Falls, Vt.	12	23	23	13.0	23
Hartford, Conn.	16	27	(**)	22.5	30
Holyoke, Mass.	9	29	29	9.8	29
Hudson:					
Troy, N. Y.	15	14	14	16.1	14
Do.	15	18	18	16.5	18
Do.	15	27	(**)	18.3	27
Albany, N. Y.	12	18	19	13.5	18
Do.	12	27	29	14.0	27
Castleton, N. Y.	10	27	28	10.3	27
Stuyvesant, N. Y.	9	26	27	9.7	26
Mohawk:					
Tribeshill, N. Y.	16	13	13	21.6	13
Do.	16	27	27	16.8	27
Delaware (East Branch):					
Fishs Eddy, N. Y.	10	13	13	18.0	13
Do.	10	27	27	10.7	27
Lehigh:					
Allentown, Pa.	14	5	5	16.9	5
Schuylkill:					
Reading, Pa.	12	7	7	15.6	7
Susquehanna:					
Oneonta, N. Y.	12	17	18	12.9	17
Do.	12	25	(**)	14.7	27
Bainbridge, N. Y.	11	13	20	14.4	18
Do.	11	24	30	15.3	28
Binghamton, N. Y.	14	27	28	14.6	28
Towanda, Pa.	16	13	13	16.3	13
Wilkes-Barre, Pa.	20	13	14	25.6	13
Harrisburg, Pa.	17	13	14	20.1	13, 14
Chemung:					
Corning, N. Y.	16	12	13	17.2	13
Unadilla:					
New Berlin, N. Y.	8	26	31	12.0	27
Susquehanna (West Branch):					
Williamsport, Pa.	20	13	13	20.4	13
Tar:					
Greenville, N. C.	13	9	11	13.6	10
Peedee:					
Cheraw, S. C.	27	14	14	27.6	14
Santee:					
Ferguson, S. C.	12	(*)	1	12.4	1
Do.	12	8	(**)	13.7	18, 19
Rimmi, S. C.	12	6	(**)	15.7	18
Wateree:					
Camden, S. C.	24	14	14	24.0	14
Congaree:					
Columbia, S. C.	15	13	13	15.1	13
Broad:					
Blairs, S. C.	15	30	30	15.1	30
Saluda:					
Pelzer, S. C.	7	29	29	7.2	29
Chappels, S. C.	14	13	15	16.8	14
Do.	14	30	(**)	17.0	31
Broad:					
Carlton, Ga.	11	13	13	14.0	13
Do.	11	29	30	15.5	30
Oconee:					
Milledgeville, Ga.	22	18	18	22.6	18
Do.	22	29	30	26.5	30

* Continued from February.

TABLE I.—Flood stages March, 1920—Continued.

River and station.	Flood stage.	Above flood stages—dates.		Crest.	
		From—	To—	Stage.	Date.
ATLANTIC DRAINAGE—continued.					
<i>Ocmulgee:</i>	<i>Feet.</i>			<i>Feet.</i>	
Macon, Ga.....	18	17	18	19.9	18
Do.....	18	29	30	20.5	30
Abbeville, Ga.....	11	19	28	15.2	23
Lumber City, Ga.....	15	26	28	16.2	26
EAST GULF DRAINAGE.					
<i>Apalachicola:</i>					
Blountstown, Fla.....	15	21	26	16.5	23
Do.....	15	30	31	15.1	30
River Junction, Fla.....	12	14	(**)	20.1	22
<i>Flint:</i>					
Woodbury, Ga.....	10	18	18	12.0	18
Do.....	10	30	30	11.2	30
Montezuma, Ga.....	20	20	20	20.2	20
Albany, Ga.....	20	24	26	22.9	24
<i>Chattahoochee:</i>					
Alaga, Ala.....	30	20	22	34.0	21
<i>Alabama:</i>					
Montgomery, Ala.....	35	19	23	41.9	21
Selma, Ala.....	35	19	26	44.9	22
Do.....	35	31	(**)	35.7	31
<i>Cahaba:</i>					
Centerville, Ala.....	25	18	18	28.3	18
<i>Tombigbee:</i>					
Aberdeen, Miss.....	33	14	16	36.2	15
Demopolis, Ala.....	39	17	(**)	56.4	27
<i>Black Warrior:</i>					
Tuscaloosa, Ala.....	46	18	21	51.6	20
<i>Pearl:</i>					
Jackson, Miss.....	20	14	(**)	26.5	27
WEST GULF DRAINAGE.					
<i>Trinity:</i>					
Fort Worth, Tex.....	20	25	25	27.7	25
Dallas, Tex.....	25	25	28	35.3	26
Trinidad, Tex.....	28	31	31	31.3	31
GREAT LAKES DRAINAGE.					
<i>St. Joseph:</i>					
Montpelier, Ohio.....	10	6	8	12.4	7
Do.....	10	12	14	12.2	13
<i>Saginaw:</i>					
Saginaw, Mich.....	19	16	20	20.2	18
<i>Pine:</i>					
Alma, Mich.....	6	12	12	7.5	12
Do.....	6	16	19	8.5	16
<i>Chippewa:</i>					
Chippewa Falls, Wis.....	16	27	27	16.3	27
Mount Pleasant, Mich.....	12	12	17	13.2	12
<i>Grand:</i>					
Eaton Rapids, Mich.....	6	12	14	6.4	12, 13
Lansing, Mich.....	11	13	14	11.4	13
Grand Ledge, Mich.....	6	12	18	11.4	14
Ionia, Mich.....	21	14	17	21.6	17
Lowell, Mich.....	15	15	18	16.5	17
Grand Rapids, Mich.....	11	16	21	14.9	16, 17
East Lansing, Mich.....	8	12	17	10.7	13
<i>Cedar:</i>					
Williamston, Mich.....	10	12	15	10.6	12
HUDSON BAY DRAINAGE.					
<i>Red River of the North:</i>					
Grand Forks, N. Dak.....	35	28	31	35.8	29
MISSISSIPPI DRAINAGE (OHIO BASIN).					
<i>Ohio:</i>					
Pittsburgh, Pa.....	22	13	14	25.2	13
Beaver Dam, Pa.....	30	13	15	36.5	14
Marietta, Ohio.....	33	15	16	34.8	15
Point Pleasant, W. Va.....	40	17	22	45.0	20
Dam No. 29, Normal, Ky.....	50	20	22	53.5	21
Dam No. 30, Oliver, Ky.....	52	21	21	52.5	21
Portsmouth, Ohio.....	50	20	22	52.9	21
Maysville, Ky.....	50	20	23	52.0	22
Cincinnati, Ohio.....	46	19	24	54.6	22
Madison, Ind.....	46	21	24	47.8	23
Louisville, Ky.....	28	20	25	31.5	23
Cloverport, Ky.....	40	19	27	46.7	23, 24
Henderson, Ky.....	33	18	(**)	41.2	25, 26
Evansville, Ind.....	35	18	(**)	42.8	24, 25
Mount Vernon, Ind.....	35	19	(**)	43.2	26
Shawneetown, Ill.....	35	18	(**)	46.0	27
Paducah, Ky.....	43	23	(**)	45.3	28
Cairo, Ill.....	45	20	(**)	51.4	31
<i>Allegheny:</i>					
Olean, N. Y.....	12	13	14	14.7	13
Warren, Pa.....	12	13	14	13.8	13
Franklin, Pa.....	15	13	14	18.6	13
Parkers Landing, Pa.....	18	13	14	21.8	13
Mosgrove, Pa.....	20	13	14	25.0	13
Freeport, Pa.....	22	13	14	27.2	13
Lock No. 3, Springdale, Pa.....	27	13	15	33.0	13
Herr Island Dam, Pa.....	22	13	14	28.1	13

** Continued into April.

TABLE I.—Flood stages March, 1920—Continued.

River and station.	Flood stage.	Above flood stages—dates.		Crest.	
		From—	To—	Stage.	Date.
MISSISSIPPI DRAINAGE (OHIO BASIN)—CON.					
<i>Kiskiminetos:</i>	<i>Feet.</i>			<i>Feet.</i>	
Saltsburg, Pa.....	8	5	5	11.0	5
Do.....	9	13	13	9.8	13
<i>Stony Creek:</i>					
Johnstown, Pa.....	10	12	12	11.0	12
<i>Beaver:</i>					
Beaver Falls, Pa.....	11	13	13	11.3	13
<i>Shenango:</i>					
Sharon, Pa.....	9	12	14	13.2	13
<i>Tuscarawas:</i>					
Norris Point, Ohio.....	8	5	7	10.1	6
Do.....	8	13	16	9.4	13
Coshocton, Ohio.....	8	13	14	9.6	13
Do.....	8	17	17	8.1	17
<i>Walhonding:</i>					
Walhonding, Ohio.....	8	5	6	10.6	5
Do.....	8	12	13	10.0	13
Do.....	8	17	17	8.0	17
<i>Scioto:</i>					
La Rue, Ohio.....	11	4	6	12.0	5
Circleville, Ohio.....	10	6	6	10.0	6
Do.....	10	13	13	10.3	13
<i>Kentucky:</i>					
Beattyville, Ky.....	30	20	20	30.0	20
<i>Green:</i>					
Lock No. 2, Rumsey, Ky.....	34	20	29	33.8	26
Lock No. 4, Woodbury, Ky.....	33	20	24	33.2	22
<i>Wabash:</i>					
Lafayette, Ind.....	11	13	13	12.1	13
Do.....	11	17	18	11.7	17
Mount Carmel, Ill.....	15	15	28	20.0	22
<i>White:</i>					
Decker, Ind.....	18	17	26	20.8	21.22
East Fork—					
Shoals, Ind.....	20	19	23	21.7	20
<i>Big Pigeon:</i>					
Newport, Tenn.....	6	17	17	6.6	17
<i>Tennessee:</i>					
Knoxville, Tenn.....	12	20	21	13.0	20
Riverton, Ala.....	32	13	26	36.7	15
<i>Holston (North Fork):</i>					
Mendota, Va.....	8	20	20	9.1	20
<i>Clinch:</i>					
Clinton, Tenn.....	25	14	15	25.8	15
<i>Duck:</i>					
Columbia, Tenn.....	30	14	14	31.0	14
<i>Mississippi:</i>					
Reeds, Minn.....	12	29	(**)	12.3	30
Winona, Minn.....	16	31	(**)	16.0	31
La Crosse, Wis.....	12	29	(**)	13.8	31
Keokuk, Iowa.....	14	29	(**)	14.4	30
Warsaw, Ill.....	17	29	(**)	17.4	29
Hannibal, Mo.....	13	27	(**)	16.6	30
Louisiana, Mo.....	12	27	(**)	14.9	30
Quincy, Ill.....	14	27	(**)	16.1	30
Grafton, Ill.....	18	29	(**)	20.2	31
Alton, Ill.....	21	28	(**)	24.5	31
Chester, Ill.....	27	31	(**)	27.1	31
Cape Girardeau, Mo.....	30	30	(**)	31.9	31
New Madrid, Mo.....	34	20	(**)	40.0	31
Memphis, Tenn.....	35	27	(**)	37.8	31
Helena, Ark.....	42	27	(**)	45.5	31
Arkansas City, Ark.....	42	27	(**)	46.4	31
<i>Wisconsin:</i>					
Merrill, Wis.....	11	29	29	11.4	29
Wausau, Wis.....	10	26	26	10.4	26
Do.....	10	29	29	10.4	29
Knowlton, Wis.....	12	26	(**)	17.5	27
Grand Rapids, Wis.....	12	28	28	12.0	28
Portage, Wis.....	14	29	(**)	14.9	31
<i>Des Moines:</i>					
Ottumwa, Iowa.....	10	16	16	10.3	16
Do.....	10	25	28	12.3	26
<i>Illinois:</i>					
Morris, Ill.....	13	12	14	17.0	13
Do.....	13	26	30	16.2	27
Peru, Ill.....	14	8	9	14.7	9
Do.....	14	12	(**)	20.5	29
Henry, Ill.....	7	12	(**)	14.4	29, 30
Peoria, Ill.....	16	14	(**)	20.8	30, 31
Havana, Ill.....	14	15	(**)	17.1	31
Beardstown, Ill.....	12	13	(**)	18.1	31
Pearl, Ill.....	12	17	(**)	16.2	31

** Continued into April.

TABLE I.—Flood stages March, 1920—Continued.

River and station.	Flood stage.	Above flood stages—dates.		Crest.	
		From—	To—	Stage.	Date.
MISSISSIPPI DRAINAGE (OHIO BASIN)—CON.					
<i>Missouri:</i>	<i>Feet.</i>			<i>Feet.</i>	
St. Charles, Mo.....	25	28	(**)	26.4	30
<i>Grand:</i>					
Chillicothe, Mo.....	18	26	(**)	26.9	30
Brunswick, Mo.....	10	27	(**)	11.7	28, 29
<i>Osage:</i>					
Osceola, Mo.....	20	27	28	21.5	28
Warsaw, Mo.....	22	26	29	28.8	27
Tuscumbia, Mo.....	25	27	30	28.5	29
<i>Meramec:</i>					
Steelville, Mo.....	12	26	26	13.6	26
Pacific, Mo.....	11	26	29	17.4	28
Glencoe, Mo.....	15	29	29	16.5	29
Valley Park, Mo.....	14	14	14	15.0	14
Do.....	14	27	29	18.6	29
<i>Bourbeuse:</i>					
Union, Mo.....	10	13	14	12.6	14
Do.....	10	27	28	12.9	27
<i>Ouachita:</i>					
Arkadelphia, Ark.....	18	26	27	20.0	27
Camden, Ark.....	30	30	(**)	33.8	31
<i>James:</i>					
Huron, S. Dak.....	9	15	(**)	15.6	28
<i>Arkansas:</i>					
Fort Smith, Ark.....	22	28	29	22.9	28
Dardanelle, Ark.....	20	29	30	20.9	29
<i>Neosho:</i>					
Fort Gibson, Okla.....	22	27	28	24.5	27
<i>Petit Jean:</i>					
Danville, Ark.....	20	26	29	24.6	26
<i>White:</i>					
Calico Rock, Ark.....	18	26	29	30.2	26
Batesville, Ark.....	23	26	30	34.0	27
Newport, Ark.....	26	28	(**)	29.3	29
Georgetown, Ark.....	22	28	(**)	24.2	31
<i>Black:</i>					
Black Rock, Ark.....	14	5	9	17.0	5
Do.....	14	12	(**)	20.9	27
<i>Little:</i>					
Whitecliffs, Ark.....	28	28	29	29.1	28
<i>Sulphur:</i>					
Finley, Tex.....	24	27	(**)	28.0	29, 30
Ringo Crossing, Tex.....	20	26	30	28.0	26

** Continued into April.

MEAN LAKE LEVELS DURING MARCH, 1920.

By UNITED STATES LAKE SURVEY.

[Dated: Detroit, Mich., Apr. 6, 1920.]

The following data are reported in the "Notice to Mariners" of the above date:

Data.	Lakes.*			
	Superior.	Michigan and Huron.	Erie.	Ontario.
Mean level during March, 1920:	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>
Above mean sea level at New York.....	601.92	580.00	570.85	245.05
Above or below—				
Mean stage of February, 1920.....	+0.01	+0.05	+0.05	+0.04
Mean stage of March, 1919.....	+0.03	-0.73	-1.64	-0.96
Average stage for March, last 10 years.....	+0.28	0.00	-0.90	-0.62
Highest recorded March stage.....	-0.36	-2.95	-3.00	-2.76
Lowest recorded March stage.....	+1.26	+0.89	+0.02	+0.75
Average relation of the March level to—				
February level.....		+0.1	+0.1	+0.2
April level.....		-0.3	-0.6	-0.7

* Lake St. Clair's level: In March, 574 feet.